



Status of TES limb nitric acid

Preview of TES v003 data

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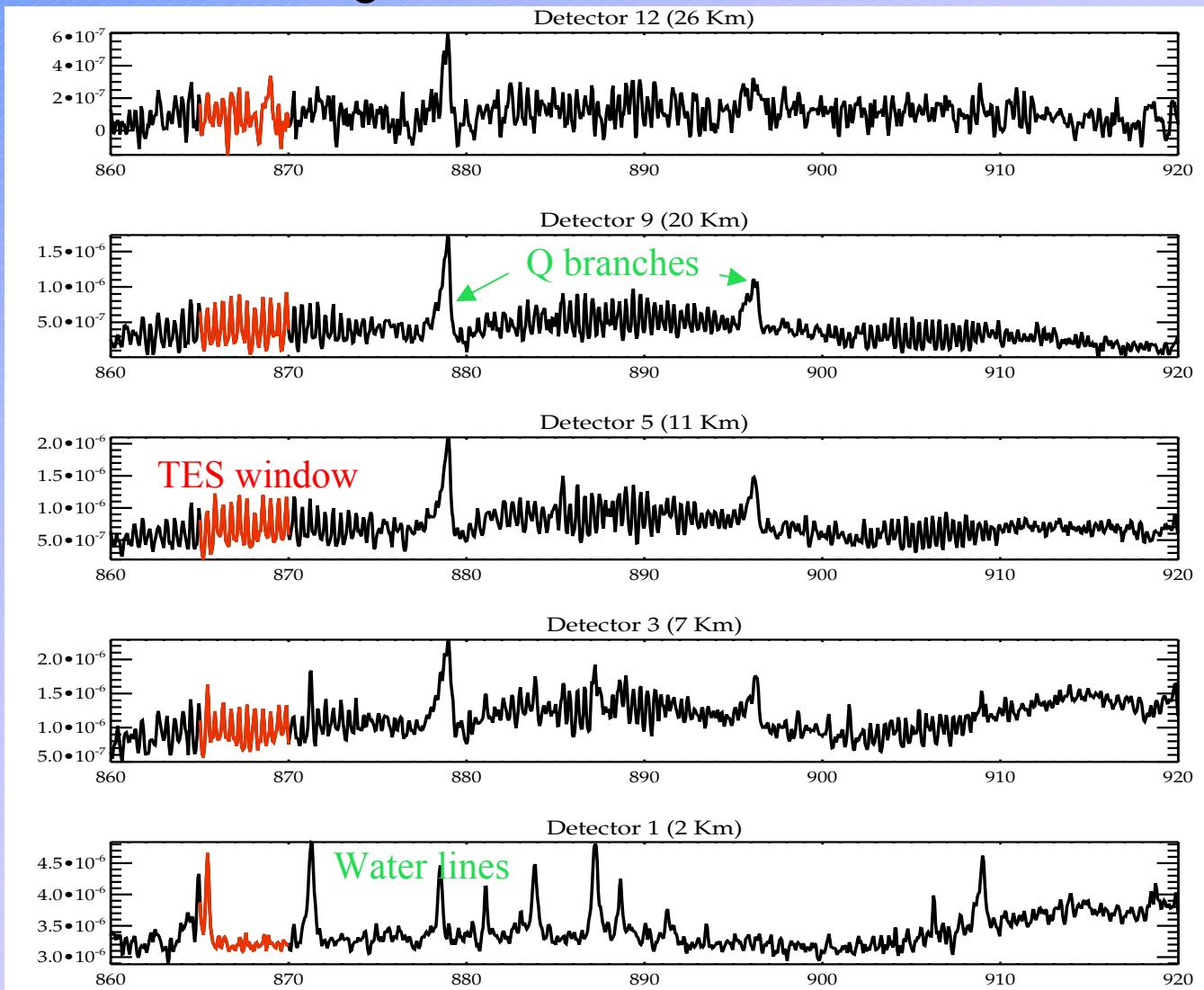
Thanks to Michelle Santee and Peter Popp

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TES HNO₃ spectra observed by TES



26 km

20 km

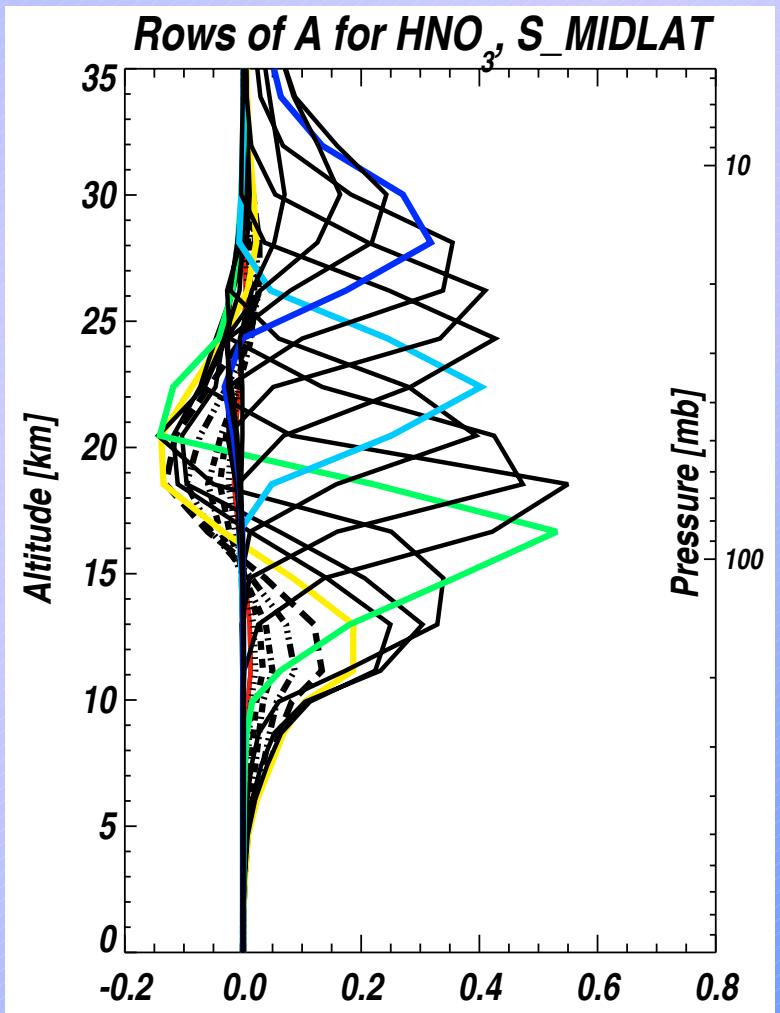
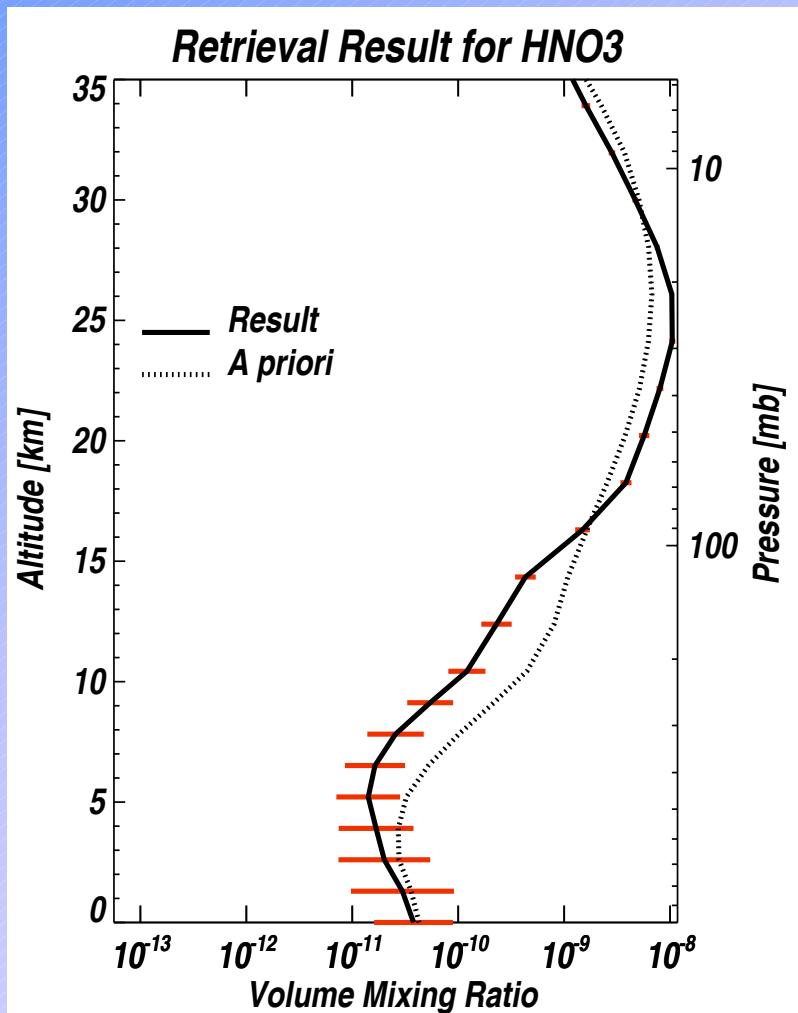
11 km

7 km

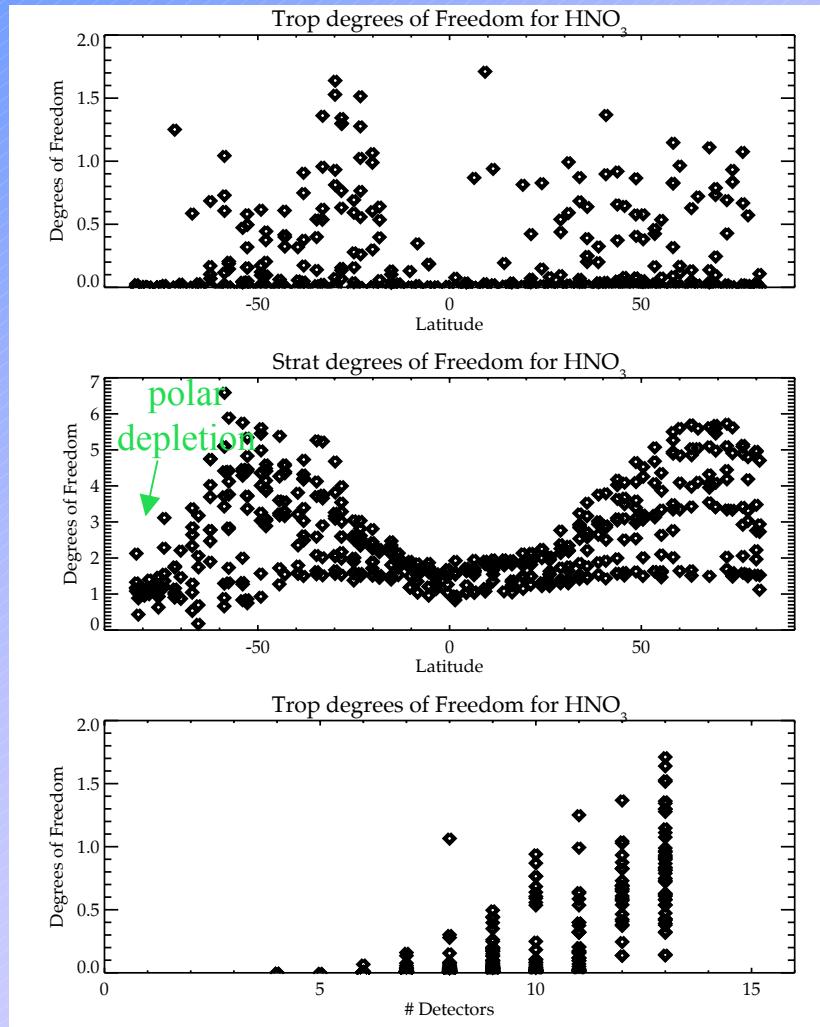
3 km



Nitric Acid retrieval example



TES HNO₃ sensitivity



Tropospheric sensitivity

TES has between 0 and 2 degrees of freedom for upper tropospheric HNO₃. The peak is in the mid-latitudes due to more cloud-free scenes.

Stratospheric sensitivity

The peak sensitivity occurs at the poles, where the HNO₃ concentration is highest. The dip at the South Pole is due to S. Polar winter HNO₃ depletion.

Sensitivity vs. # of detectors. Detectors are dropped due to cloud detection -- unlike nadir we currently do not retrieve cloud properties



TES HNO₃ measurements

- 73 global surveys between 9/20/04 and 5/20/05
- Extensive special observations in the Pacific during INTEX-B
- A few limb measurements during aircraft campaigns (CRAVE, PAVE)

TES HNO₃ products at the DAAC

- V002: stratospheric limb retrievals (current version at DAAC)
- V003: HNO₃ retrievals above clouds – *coming soon to a DAAC near you!*

Validation opportunities

- **PAVE – SAGA.** 1 step & stare observation, TES data 1/28/05, SAGA data 1/27/05
- **CRAVE – NOAA CIMS** validation data for upper trop/lower strat. (200 - 65 hPa) offset 1 day from TES. 2 step & stare observations.
- **INTEX-B – SAGA.** validation data between 8 and 13 km. 2 step & stare observations co-located.
- **MLS** – Stratospheric, possibly upper-trop (v2.1). Can make daily comparisons and develop statistics. Note, the MLS groundtrack is offset by 200 km.
- **ACE** – Have not yet compared to ACE. Excellent validation possibilities, limited dataset weighted to poles
- **MIPAS** –Similar instrument. Some data overlap issues
- **GEOS-CHEM** – Tropospheric comparisons and pattern analysis
- **Mark IV** – From 6 km to upper strat, limited number of profiles, e.g. 9/23/04
- **FIRS** – Uses ν_9 band but can also use same windows as TES. Limited number of profiles, e.g. 9/23/04

Statistical comparison to MLS

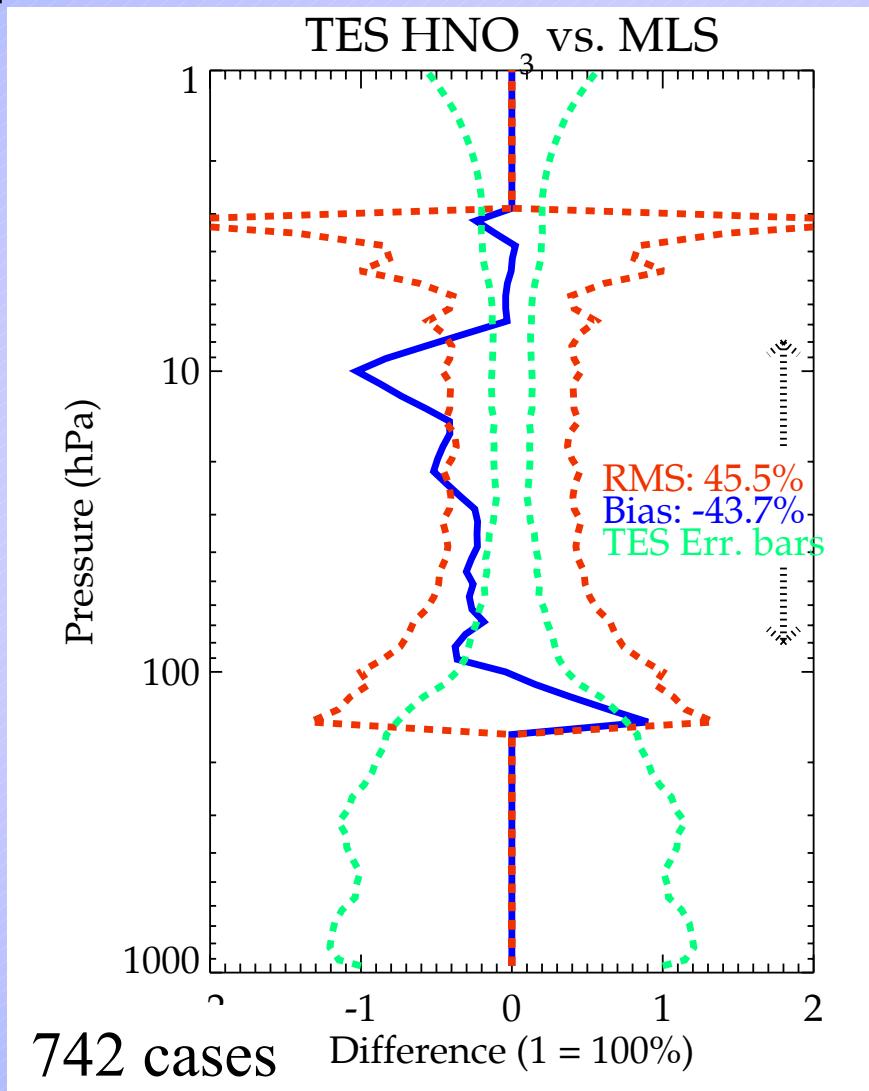
Data from 1 TES global survey (9/20/04, **v003**), matching each TES observation to the closest MLS target (**v1.51**) using quality flags (note MLS targets \sim 200 km away)

RESULTS

Between 8 and 80 hPa TES has a **-44% bias** compared to MLS

TES has a **46% standard deviation** compared to MLS, much larger than the TES error bars

Larger variability near the edge of the MLS reported values



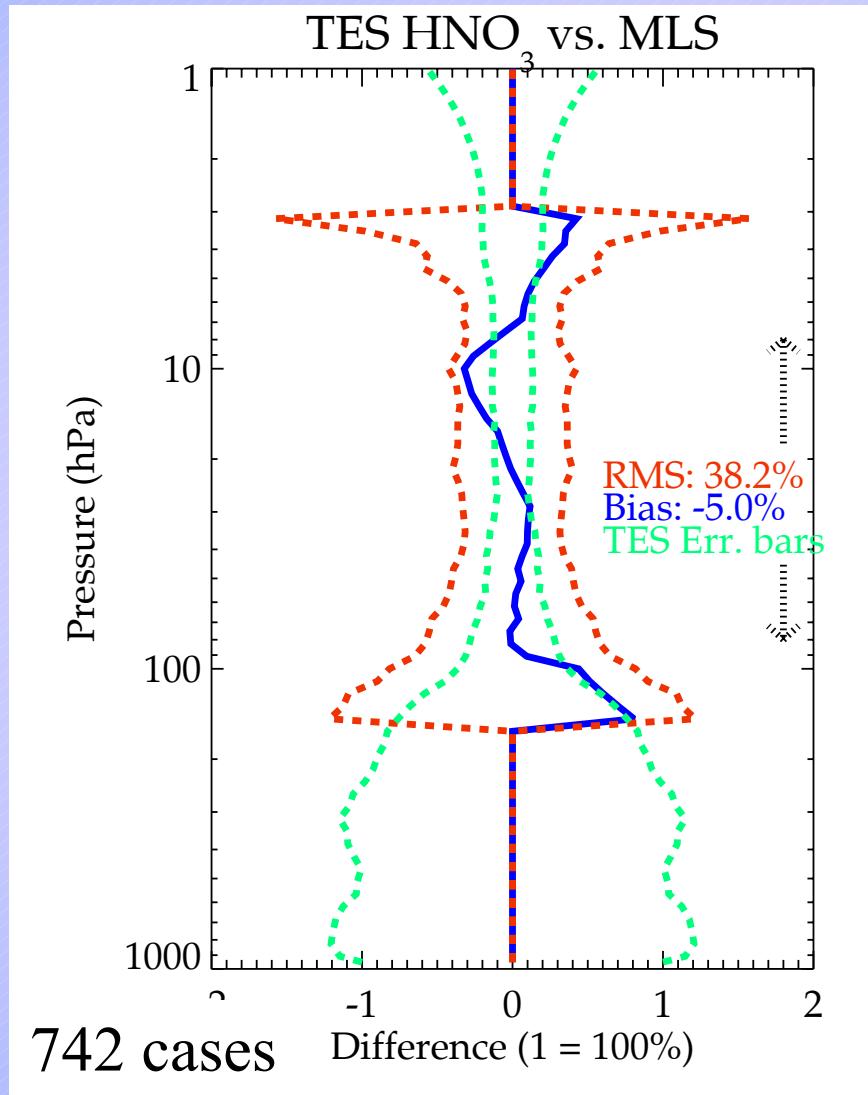
Comparison to MLS v2.10

Closest matching runs are 3 days apart

RESULTS

Bias improves significantly over v1.51. Note TES has a 50% negative bias near 10 hPa.

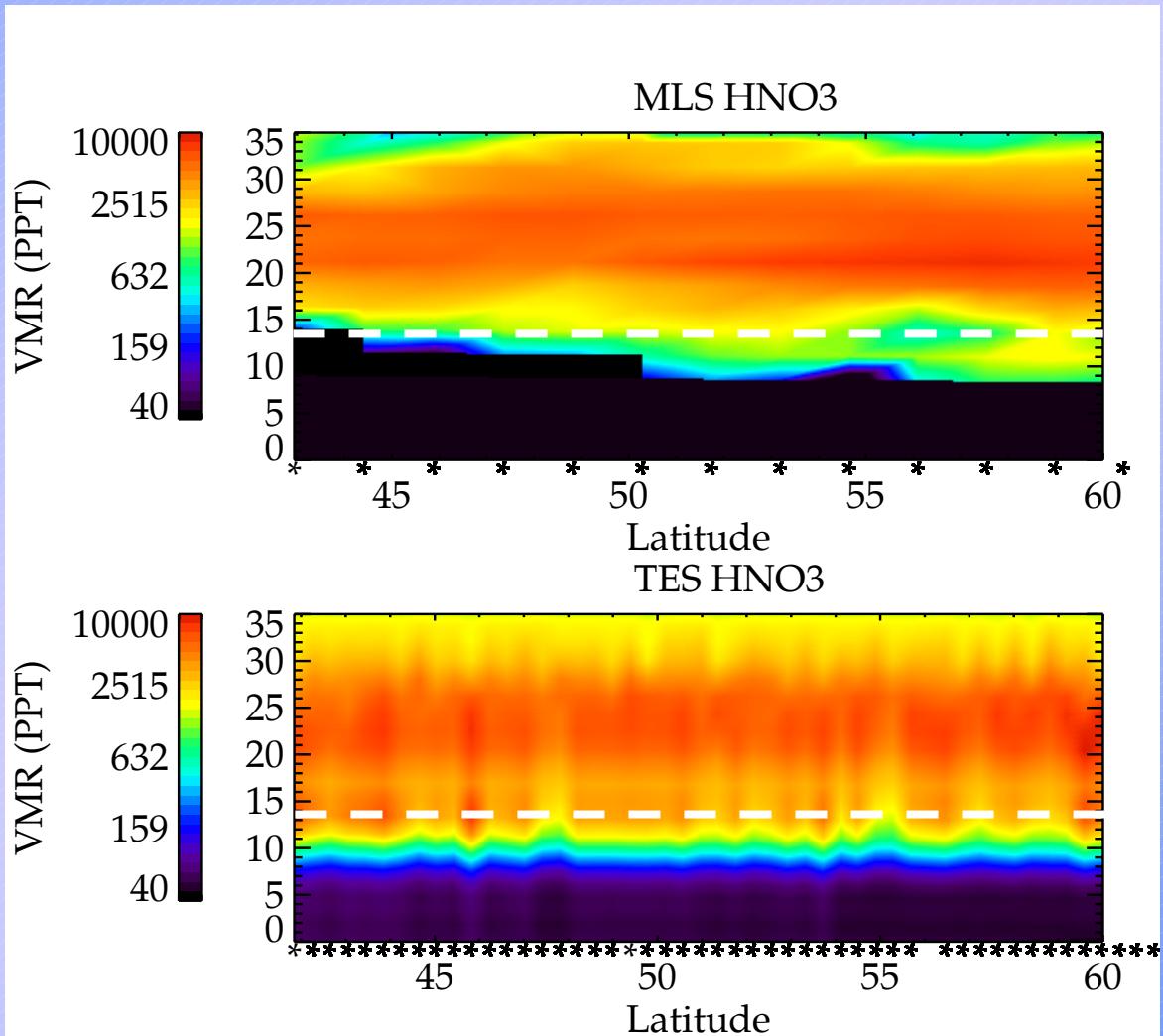
The standard deviation also improves somewhat, but is still larger than the TES error bars



INTEX-B comparing TES and MLS v2.1

MLS v2.1 preliminary data (did not use quality flags for MLS)

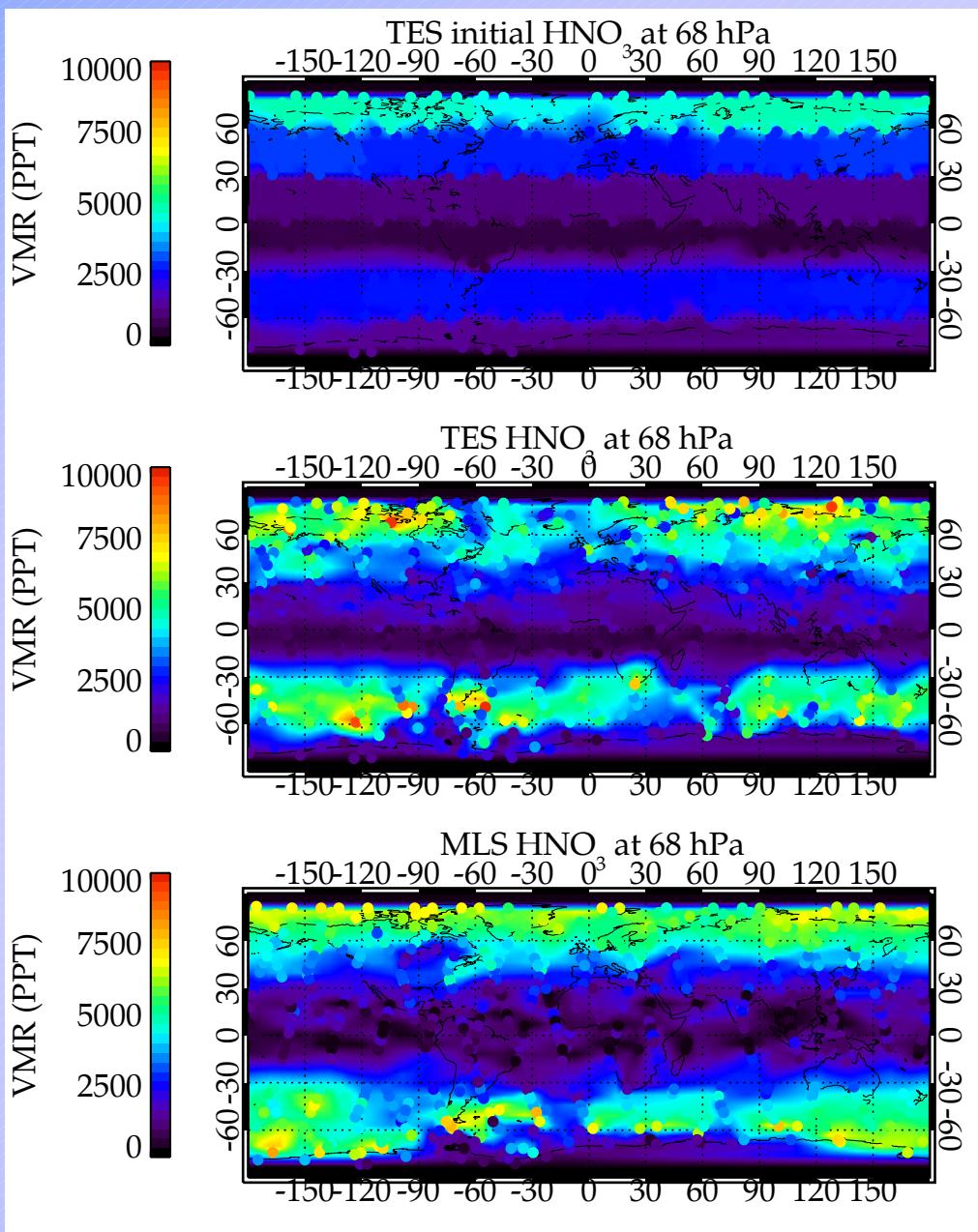
TES is high vs. MLS in the 10-15 km range. Comparisons to SAGA will be very useful!!



TES(v003) and MLS(v2.1) Global comparison, 68 hPa

Similar overall patterns

- TES and MLS shows Antarctic HNO₃ depletion
- TES shows higher arctic HNO₃ levels in some places



9/20/04

9/23/04

10



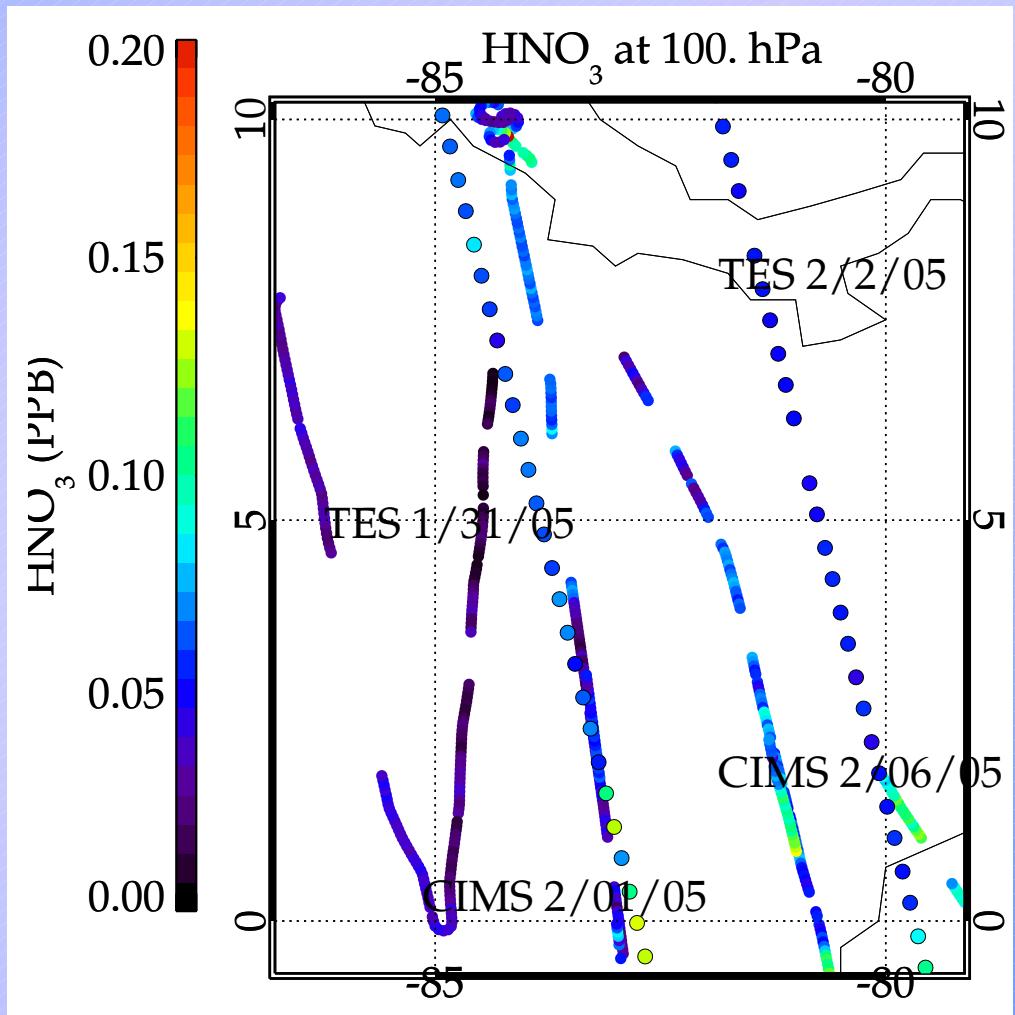
S. Kulawik - Aura Science Mtg - Sept 2006

Preliminary comparison to CIMS

Coincidences off by 1 or more days

Upper trop/lower stratosphere measurements

Preliminary comparisons show similar values in similar areas



Conclusions

- TES sees global patterns similar to MLS. TES has a -5% bias and 38% variability with respect to MLS (v2.1) between 8 and 80 hPa (larger than TES or MLS error bars).
- TES compares reasonably well to CIMS, but hard to definitively validate without exact coincidences
- Looking forward to more CIMS, SAGA, ACE, MIPAS, FIRS, and Mark IV comparisons

Notes

- TES radiance residuals show a negative bias → may need to include grey-body
- TES is currently using only a small fraction of the HNO₃ band. Will use more of the band when have more confidence in spectroscopy / calibration / validation
- Validation paper in IEEE special issue if enough TES v003 data is processed (depends on GMAO release date)